

Claims:

- 1 1. An apparatus for depositing and planarizing a material on a substrate, comprising:
- 2 a) a partial enclosure defining a processing region and having a fluid inlet and a
- 3 fluid outlet;
- 4 b) a shaft connected to the partial enclosure on one end and to an actuator on an
- 5 opposing end thereof and adapted to rotate the partial enclosure;
- 6 c) a permeable disc disposed in the partial enclosure;
- 7 d) a diffuser plate disposed in the partial enclosure and positioned below the
- 8 permeable disc; and
- 9 e) a substrate carrier movably disposed above the permeable disc, the substrate
- 10 carrier having a substrate mounting surface and a plurality of electrical contacts disposed about
- 11 the perimeter of the substrate receiving surface.
- 1 2. The apparatus of claim 1, further comprising a second fluid inlet disposed above the
- 2 permeable disc to deliver a fluid onto the permeable disc.
- 1 3. The apparatus of claim 1, wherein the first fluid inlet is disposed in a portion of the
- 2 shaft fluidly connected with the partial enclosure.
- 1 4. The apparatus of claim 1, wherein the diffuser plate is made of a plastic.
- 1 5. The apparatus of claim 1, further comprising an anode disposed in the partial enclosure
- 2 below the diffuser plate.
- 1 6. The apparatus of claim 1, wherein the permeable disc comprises polyurethane.
- 1 7. The apparatus of claim 1, wherein the diffuser plate is comprised of a material selected
- 2 from the group of fluoropolymers, PE, HDPE, UHMW and combinations thereof.
- 1 8. The apparatus of claim 7, wherein the diffuser plate comprises a plurality of holes

2 formed therein.

1 9. The apparatus of claim 1, wherein the permeable disc comprises a plurality of pores
2 disposed therein for flow of material therethrough.

1 10. The apparatus of claim 1, wherein the permeable disc further comprises grooves.

1 11. The apparatus of claim 5, wherein the anode is a consumable comprising the same
2 material as a conductive material to be deposited on a substrate surface.

1 12. The apparatus of claim 5, wherein the anode is in contact with the permeable disk.

1 13. The apparatus of claim 5, further comprising a membrane disposed between the anode
2 and permeable disk.

1 14. The apparatus of claim 1, wherein apparatus provides orbital motion, circular rotation,
2 translational motion, or linear motion between the wafer and the permeable disk.

1 15. A processing system for forming a planarized layer on a substrate, comprising:

2 a) a processing platform having two or more processing stations, a loading station
3 and a substrate transfer device disposed above the processing stations and the loading station;

4 b) a processing apparatus positioned at each processing station, the processing
5 apparatus comprising:

6 (i) a partial enclosure defining a processing region and having a fluid inlet
7 and a fluid outlet;

8 (ii) a shaft connected to the partial enclosure on one end and to an actuator
9 on an opposing end thereof and adapted to rotate the partial enclosure;

10 (iii) a permeable disc disposed in the partial enclosure;

11 (iv) a diffuser plate disposed in the partial enclosure and positioned below
12 the permeable disc; and

13 (v) a substrate carrier movably disposed above the permeable disc, the

14 substrate carrier having a substrate mounting surface and a plurality of electrical
15 contacts disposed about the perimeter of the substrate receiving surface.

1 16. The processing system of claim 15, further comprising a second fluid inlet disposed
2 above the permeable disc to deliver a fluid onto the permeable disc.

1 17. The processing system of claim 15, wherein the first fluid inlet is disposed in a portion
2 of the shaft fluidly connected with the partial enclosure.

1 18. The processing system of claim 15, wherein the diffuser plate is made of a plastic.

1 19. The processing system of claim 15, further comprising an anode disposed in the partial
2 enclosure below the diffuser plate.

1 20. The processing system of claim 15, wherein the permeable disc comprises
2 polyurethane.

1 21. The processing system of claim 15, wherein the diffuser plate is comprised of a
2 material selected from the group of fluoropolymers, PE, HDPE, UHMW and combinations
3 thereof.

1 22. The processing system of claim 15, wherein the permeable disc comprises a plurality of
2 pores disposed therein for flow of material therethrough.

1 23. The processing system of claim 15, wherein the permeable disk further comprises
2 grooves

1 24. The processing system of claim 19, wherein the anode is a consumable comprising the
2 same material as a conductive material to be deposited on a substrate surface

1 25. The processing system of claim 19, wherein the anode is in contact with the permeable

2 disk

1 26. The processing system of claim 15, wherein the apparatus provides orbital motion,
2 circular rotation, translational motion, or linear motion between the wafer and the permeable
3 disk.

1 27. The processing system of claim 15, further comprising a membrane disposed between
2 the anode and permeable disk.

1 28. The processing system of claim 15, further comprising one or more additional
2 processing stations capable of polishing conductive materials from the substrate surface.

1 29. The processing system of claim 15, further comprising one or more additional
2 processing stations capable of polishing dielectric materials from the substrate surface.

1 30. A method of processing a substrate, comprising:

2 a) positioning the substrate in an electrolyte solution a first distance from a
3 permeable disc disposed in the electrolyte;

4 b) applying a current to a surface of the substrate exposed to the electrolyte and
5 depositing a material on the substrate;

6 c) positioning the substrate a second distance from the permeable disc, the second
7 distance being less than the first distance; and

8 d) depositing the material on the substrate at the second distance.

1 31. The method of claim 30, wherein the electrolyte is a copper containing solution.

1 32. The method of claim 31, wherein less than 5000 angstroms of material is deposited at
2 the first distance.

1 33. The method of claim 30, wherein the current is applied in a range from about 20 amps
2 or less.

- 1 34. The method of claim 30, wherein the permeable disc is a polishing pad.
- 1 35. The method of claim 34, wherein applying the current to the substrate comprises the
2 use of a pulse plating technique.
- 1 36. The method of claim 30, wherein the first distance is between about 1 mm and about 5
2 mm.
- 1 37. The method of claim 36, wherein the second distance is between about 100 μm or less.
- 1 38. The method of claim 36, wherein the substrate and the permeable disk are in contact
2 when depositing the material on the substrate at the second distance.
- 1 39. The method of claim 30, further comprising transferring the substrate to a polishing
2 apparatus.
- 1 40. The method of claim 39, wherein the substrate has a surface comprising a dielectric
2 layer with feature definitions formed therein, a barrier layer conformally deposited on the
3 dielectric layer and in the feature definitions formed therein, wherein the method deposits a
4 copper containing material on the barrier layer.
- 1 41. The method of claim 40, further comprising:
2 e) removing residual copper containing materials;
3 f) removing the barrier layer; and
4 g) buffing the substrate surface to remove defects formed thereon.
- 1 42. The method of claim 38, wherein the permeable disk exerts a pressure on the substrate
2 of about 2 psi or less at the second distance.
- 1 43. The method of claim 30, wherein the current is applied in a range between about 0.5

2 amps and about 5.0 amps.

1 44. The method of claim 43, wherein features of 1 micron or less are substantially filled at
2 the first distance.

1 45. The method of claim 33, wherein features of 1 micron or more are substantially filled at
2 the second distance.

1 46. A method of processing a substrate, comprising:
2 positioning the substrate in an electrolyte solution a first distance from a permeable disc
3 disposed in the electrolyte; and
4 applying a current to a surface of the substrate exposed to the electrolyte and depositing
5 a material on the substrate.

1 47. The method of claim 46, further comprising positioning the substrate a second distance
2 from the permeable disc, the second distance being less than the first distance.

1 48. The method of claim 47, further comprising depositing the material on the substrate at
2 the second distance.

1 49. The method of claim 46, wherein the electrolyte is a copper containing solution.

1 50. The method of claim 49, wherein less than 5000 angstroms of material is deposited at
2 the first distance.

1 51. The method of claim 46, wherein the current is applied in a range from about 20 amps
2 or less.

1 52. The method of claim 46, wherein the permeable disc is a polishing pad.

1 53. The method of claim 47, wherein applying the current to the substrate comprises the
2 use of a pulse plating technique.

1 54. The method of claim 46, wherein the first distance is between about 1 mm and about 5
2 mm.

1 55. The method of claim 54, wherein the second distance is between about 100 μ m or less.

1 56. The method of claim 54, wherein the substrate and the permeable disk are in contact
2 when depositing the material on the substrate at the second distance.

1 57. The method of claim 46, further comprising transferring the substrate to a polishing
2 apparatus.

1 58. The method of claim 57, wherein the substrate has a surface comprising a dielectric
2 layer with feature definitions formed therein, a barrier layer conformally deposited on the
3 dielectric layer and in the feature definitions formed therein, wherein the method deposits a
4 copper containing material on the barrier layer.

1 59. The method of claim 58, further comprising:
2 removing residual copper containing materials;
3 removing the barrier layer; and
4 buffing the substrate surface to remove defects formed thereon.

1 60. The method of claim 55, wherein the permeable disk exerts a pressure on the substrate
2 of about 2 psi or less at the second distance.

1 61. The method of claim 46, wherein the current is applied in a range between about 0.5
2 amps and about 5.0 amps.

1 62. The method of claim 61, wherein features of 1 micron or less are substantially filled at

2 the first distance.

1 63. The method of claim 51, wherein features of 1 micron or more are substantially filled at
2 the second distance.

1 64. A method of processing a substrate, comprising:
2 positioning the substrate in an electrolyte solution a first distance from a permeable disc
3 disposed in the electrolyte and depositing a material on the substrate by an electroless
4 deposition technique;
5 positioning the substrate a second distance from the permeable disc, the second distance
6 being less than the first distance; and
7 depositing the material on the substrate at the second distance by an electroless
8 deposition technique.

1 65. The method of claim 64, wherein the electrolyte is a copper containing solution.

1 66. The method of claim 65, wherein less than 5000 angstroms of material is deposited at
2 the first distance.

1 67. The method of claim 64, wherein the permeable disc is a polishing pad.

1 68. The method of claim 64, wherein the first distance is between about 1 mm and about 5
2 mm.

1 69. The method of claim 68, wherein the second distance is between about 100 μm or less.

1 70. The method of claim 68, wherein the substrate and the permeable disk are in contact
2 when depositing the material on the substrate at the second distance.

1 71. The method of claim 64, further comprising transferring the substrate to a polishing
2 apparatus.

1 72. The method of claim 71, wherein the substrate has a surface comprising a dielectric
2 layer with feature definitions formed therein, a barrier layer conformally deposited on the
3 dielectric layer and in the feature definitions formed therein, wherein the method deposits a
4 copper containing material on the barrier layer.

1 73. The method of claim 72, further comprising:
2 removing residual copper containing materials;
3 removing the barrier layer; and
4 buffing the substrate surface to remove defects formed thereon.

1 74. The method of claim 70, wherein the permeable disk exerts a pressure on the substrate
2 of about 2 psi or less at the second distance.

1 75. The method of claim 64, wherein the polishing pad comprises a non-conductive
2 material.

1 76. The method of claim 64, wherein features of 1 micron or less are substantially filled at
2 the first distance.

1 77. The method of claim 64, wherein features of 1 micron or more are substantially filled at
2 the second distance.

1 78. A method for processing a substrate surface, comprising:
2 providing a substrate comprising a dielectric layer with feature definitions formed
3 therein, a barrier layer conformally deposited on the dielectric layer and in the feature
4 definitions formed therein;
5 depositing a copper containing material on the barrier layer while planarizing the copper
6 containing material formed thereon;
7 polishing the substrate surface on a first platen to remove residual copper containing
8 materials;

9 polishing the substrate surface on a second platen to remove the barrier layer; and
10 buffing the substrate surface on a third platen to remove defects formed thereon.

1 79. The method of claim 78, further comprising transferring the substrate to a cleaning unit
2 to further reduce any defects formed on the substrate surface.

1 80. The method of claim 78, wherein the first platen, second platen, and/or the third platen
2 comprise a rotational, stationary or linear polishing pad.

1 81. The method of claim 78, wherein the first platen, second platen, and/or the third platen
2 comprise a fixed abrasive polishing pad.

1 82. The method of claim 78, wherein the substrate has a surface comprising a dielectric
2 layer with feature definitions formed therein, a barrier layer conformally deposited on the
3 dielectric layer and in the feature definitions formed therein, wherein the method deposits a
4 copper containing material on the barrier layer.

1 83. The method of claim 78, wherein depositing a copper containing material on the barrier
2 layer while planarizing the copper containing material formed thereon comprises

3 a) positioning the substrate in an electrolyte solution a first distance from a
4 permeable disc disposed in the electrolyte and depositing a material on the substrate; and

5 b) positioning the substrate a second distance from the permeable disc, the second
6 distance being less than the first distance; and

7 c) depositing the material on the substrate at the second distance.

1 84. The method of claim 83, wherein the material is deposited by an electroless deposition
2 technique.

1 85. The method of claim 83, wherein the first distance is between about 1 mm and about 5

2 mm.

1 86. The method of claim 83, wherein the second distance is between about 100 μm or less.

1 87. The method of claim 83, further comprising applying a current to a surface of the
2 substrate exposed to the electrolyte to deposit the material on the substrate at the first distance
3 and the second distance.

1 88. The method of claim 87, wherein the current is applied of about 20 amps or less during
2 deposition of the material.

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